

A BIOGRAPHICAL ACCOUNT OF HAROLD COMPERE (1896–1978), BIOLOGICAL CONTROL FOREIGN EXPLORER

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Abstract.—An historical account is provided for Harold Compere, a biological control foreign explorer for the University of California (1923–1963). Compere's early involvement in aviation and its application to entomology are discussed. Some of his foreign exploration exploits are reported and success with control of citrophilous mealybug is noted. His taxonomic and morphological interests in parasitic Hymenoptera are discussed. A bibliography of Harold Compere's scientific publications is provided.

Key Words.—George Compere, biological control, foreign exploration, citrophilous mealybug [*Pseudococcus calceolariae*], black scale [*Saissetia oleae*], California red scale [*Aonidiella aurantii*], parasitic Hymenoptera, taxonomy, morphology

Biographical notes and observations provide a point of reference which time and memory otherwise diminish. This account reviews high points in the life of Harold Compere. He had no children or direct descendants; he was not a subscribing or participating member of any scientific society and he did not supervise graduate students. Consequently his passing has gone largely unrecognized. For more than 40 years Harold Compere served the University of California and State of California as a foreign explorer and research entomologist. His contribution to biological control of citrus pests was substantial and his contribution to the systematics of parasitic Hymenoptera was noteworthy. The following notes serve to document some of his accomplishments.

EARLY YEARS

Harold Compere was born on 17 Jan 1896 on Washington Street, Los Angeles, California (Fig. 1). His mother, Amy Caypless Compere, was born in Bridgeport, Connecticut. His father, George Compere (1858–1928), was born in Davenport, Iowa. The elder Compere was a prominent figure in southern California agriculture and an early foreign explorer for biological control. George Compere was at least indirectly responsible for Harold's involvement with biological control. The elder Compere moved to California in 1874. During 1878 George was in charge of the Vejar Orchard which was seriously infested with black scale. In 1891 he became a horticulture inspector for Los Angeles County. George was a pioneer in foreign exploration and in 1898 he accepted a position in Hawaii to search for beneficial insects, first in Australia and Hong Kong. In 1901 he was employed by the Western Australia Department of Agriculture to search for natural enemies; in 1904 he was jointly employed by the State of California and Western Australia to search for natural enemies of injurious insects. George held the post of Entomologist to the Bureau of Agriculture of Western Australia until 1910. In 1908 he went to China and took parasites of red scale to Perth. When he returned to California,

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Figure 1. Harold Compere in a photograph taken about 1901.

George accepted a position as a port inspector in San Francisco. For an account of George Compere's entomological activities see Howard (1930), Essig (1931) and an anonymous obituary (1935).

Harold Compere lacked a formal education but succeeded in an academic environment despite this apparent handicap. By his own account he repeatedly dropped out of elementary school but was forced to return by his mother. His last classroom training was at Lincoln High School in Santa Monica, where he finally quit the 9th grade in 1912. Harold Compere thought he would like to become a fisherman. After leaving school he went to work as a deck hand on a pleasure boat, the McKinley, which operated off "Frazer's Million Dollar Pier" at Ocean Park. He was paid eight dollars a week, but the job did not last long. He told the writer on more than one occasion that the fishing business involved too much physical labor. However, 1 Jan 1913 found him an apprentice gardener at Golden Gate Park in San Francisco where the labor was just as intensive and his pay was \$1.50 per day.

At Golden Gate Park, Harold Compere was noticed by the park's founder, John McLaren. Apparently McLaren was impressed by Compere and his abilities. After a short while at the park, Compere was put in charge of insect control because

he apparently displayed a flair for this type of work. This aspect of his employment lasted from 1914–1915. He was called “The Professor” and to quote Compere he “. . . had the social status of a foreman but the pay of an apprentice gardener.” His terminal pay at the park was \$3.00 per day.

Compere’s professional development in entomology began to solidify during 1915. San Francisco officials announced the establishment the position of County Horticultural Commissioner. Competition for the position was open and required an examination. Compere wanted the position because it carried a salary of \$6.00 per day, an office and an expense account. He was granted a leave of absence from Golden Gate Park by McLaren and studied for the exam. McLaren told Compere that if he passed the exam, the job would be his. McLaren was a very influential person in San Francisco at the time and agreed to use his influence with the Chairman of the Board of Supervisors who made the appointment.

Compere achieved the highest score on the exam but he was not appointed to the position because he was not 21 years old. Instead, Compere became a Laboratory Assistant with the California State Commission of Horticulture on 16 Sep 1915. Compere received this offer from Harry Scott Smith (1883–1957), then Superintendent of the State Insectary at Capitol Park in Sacramento. Smith served as administrator for the County Horticultural Commissioner exam and was impressed with Compere’s performance on the written and oral examination. In effect, Compere became an assistant to Smith and served him for more than 35 years. The initial phase of the relationship was temporarily interrupted by World War I.

A few details about Smith are relevant to Compere’s story. Smith was born in Aurora, Illinois and attended the University of Nebraska (A.B. 1907; M.S. 1908; honorary Ph.D. 1953). Smith was hired by L. O. Howard (1857–1950) in 1908 to study natural enemies of the boll weevil. Smith subsequently moved to the Melrose Highlands Laboratory in Massachusetts where he worked on natural enemies imported to control gypsy moth. Smith left federal employment to try ranching in Wyoming, but returned to entomology when his efforts at livestock management failed. Smith’s first foreign exploration involved searching for natural enemies of the alfalfa weevil in Europe; one of the species he imported was useful in control of alfalfa weevil. Upon return to the United States, Smith was hired by Albert John Cook, California State Horticultural Commissioner, to serve as superintendent of the State Insectary. Smith went on to become the “father” of biological control in California and the person generally credited with coining the term “biological control.”

Harold Compere saw service as a 2nd Lieutenant in the U.S. Army Air Service during World War I. Compere was granted a leave of absence from the State Commission of Horticulture during 1917, and he enlisted as a private in the Aviation Section, Signal Enlisted Reserve Corps. His entrance into flight training was unusual because college training was a requirement, and most officers in the Army were college graduates. The Army Air Corps was even more selective. For a high-school dropout to be accepted into this prestigious program was remarkable. Compere entered the School of Military Aeronautics, University of California at Berkeley on 27 Oct 1917 and completed the course eight weeks later. Compere, with a ninth grade education, passed all examinations. He once confided that he studied after “lights out” in the latrine. His studies paid off; most students with college training failed to complete the course.

Compere received his flight training at Rockwell Field, North Island, San Diego. As part of his training he made a cross-country flight to Allessandro, Riverside County, California and became the first pilot to land at what eventually became March Air Force Base (See March Field Story, 50th Anniversary 1918–1968, p. 12). This Strategic Air Command base continues as an important military installation, and airplanes continue to fly over Compere's home in Riverside and the experiment station where he worked.

After completion of training, Compere was assigned to duty as a flight instructor at Ellington Field in Houston, Texas. Compere later stated that he desired an instructorship because duty in the war was dangerous. (The life of a pilot at the front was measured in days or weeks.) Compere's life as a pilot was not dull. Sport among stateside pilots included cloud flying and racing railroad trains. Compere participated in cloud flying until pilots were killed in accidents and he realized the dangers associated with this activity. Racing trains seemed less dangerous to Compere, but the custom was strictly prohibited by the military. Nevertheless, Compere raced trains until the day an Air Patrol spotted him. To elude authorities Compere became lost in the landing traffic, taxied his plane into a hanger and fled the scene.

Compere was responsible for the pioneering effort to use the airplane as an applied entomological tool. The story was briefly mentioned, but has gone generally unnoticed. [See "The Airplane as a Farm Scout" 29 Mar 1919, Literary Digest, 60 (13): 133–134.] During the fall of 1918 he discussed the possibilities of using the airplane in survey work with Walter D. Hunter (1875–1925), then a member of the Federal Horticulture Board and responsible for control of pink bollworm, *Pectinophora gossypiella* (Saunders), in Texas. On 23 Nov 1918 Compere forwarded a letter to the Commanding Officer of Ellington Field, requesting that permission be granted to use a military aircraft for the survey of cotton fields near Ellington. That request was disapproved by the Executive Officer, 1st Lt. J. H. Sullivan.

Subsequently, Compere wrote to L. O. Howard and indicated that the work was feasible. Howard was impressed with the possibilities of the aircraft being used for entomological purposes. On 9 Dec 1918 he forwarded Compere's letter to the Division of Military Aeronautics with an endorsement of the plan. In response, Lt. Colonel John Sullivan, Chief of the Photographic Branch and acting under orders of Major General Kenly, directed the Commanding Officer of Ellington Field to undertake the work outlined by Compere and submit a record of the work to the War Department in Washington. Sullivan's letter is dated 13 Dec 1918.

In a letter to Howard, Compere summarized the survey program. "Dr. Hunter assigned a very capable man to this work. He will be in charge and direct the pilot. A ship has been equipped with speaking tubes so that any pilot will be capable of carrying on this work when directed by a quarantine inspector. The inspector makes the charts and is responsible for the success of the work. Several days ago we made our first flight. It was a success. A storm prevented us from continuing the survey."

"I have just returned from a visit to California where I met Mr. Smith who is holding a position open for me. He urged that I immediately return to Sacramento. On returning from my visit, I found my discharge papers and also the orders to undertake the boll worm survey. I had accepted my discharge and on Tuesday

will return to California. I have made arrangements for another pilot to conduct this work. He will be under the direction of Dr. Hunter's quarantine inspector. In this work a pilot only acts as an aerial chauffeur, so that I do not feel my personal services will be of any great advantage." (Compere to Howard, 17 Jan 1919.)

The quarantine inspector selected for the work was Carl Heinrich (1880–1955) (Wade 1955). The pilot was 2nd Lt. William H. Tillisch, Harold Compere's roommate. Heinrich and Tillisch made two flights on the afternoon of 21 Jan 1919 from Ellington Field. A report of the trip was prepared by Heinrich and forwarded to Washington. Tillisch had been selected for the entomological work personally by Compere. Tillisch had intended to remain in the Army but he was killed in a scouting accident on 7 Aug 1919.

Harold Compere was discharged from the Army on 18 Jan 1919 and returned to California. The role of the airplane expanded in service of entomology. From a commercial standpoint, aerial application of pesticides on cotton was initiated about 1922 when equipment for application of dust was developed. Sprays were used from airplanes in 1930 for the control of mosquitoes. Widespread usage of the aircraft for mosquito control was established during World War II. Curiously, Compere dropped flying completely after discharge from military service. During the remainder of his life he rode as a passenger on airplanes only a few times out of medical necessity. All of his foreign exploration was conducted by ship.

Compere married Joan Tillman on 25 Aug 1919 in San Francisco. The marriage was the second for Joan, and the only marriage for Harold. Joan was born 27 Oct 1898 at Brownswood, Texas, and died during Jan 1974 at Riverside. Compere returned to employment with Smith in California under the title of Junior Entomologist, California State Department of Agriculture (1919–1921). During 1921–1923 Compere was employed as an Assistant Entomologist.

The Division of Beneficial Insect Investigations was established as a part of the Citrus Experiment Station (CES) in 1923. Several years earlier, the state legislature was convinced by progressive agriculturists that a research program for citrus and subtropical crops should be located in the southern part of the state. For an account of the Citrus Experiment Station see Boyce (1969). Riverside was selected as the site of the CES. The working group in beneficial insects represented a reorganization of the California State Commission of Horticulture. Biological control as an organized unit had been established in 1907 with construction of the State Insectary in Sacramento. The first superintendent of the Insectary was E. K. Carnes, assisted by E. J. Branigan. Carnes was succeeded as superintendent by H. S. Smith in 1913. The research program on beneficial insects became part of the Citrus Experiment Station with its CSCH staff transferred from Sacramento to Riverside. Smith was Head of the Division. Original members of the Division were Harold Compere, as foreign explorer and A. J. Basinger (1886–1984) as secretary. Philip H. Timberlake (1884–1981) was hired in 1924 to serve as a taxonomic specialist. Stanley Flanders (1894–1984) joined the group in 1929 and later served as the quarantine officer.

FOREIGN EXPLORATION

Compere's major contribution to entomology was as a foreign explorer for natural enemies of pests associated with subtropical agriculture. During a twenty

year period Compere made trips to South America, Africa, Australia and the Orient. He assumed a position similar to one held by George Compere with the state of California intermittently during the years 1899–1910. To understand why someone would be employed to wander the globe searching for insects, we must understand the agricultural conditions and views of growers regarding insect pest control. Biological control was viewed optimistically by many citrus growers. Their enthusiasm stemmed directly from the spectacular success achieved over the cottony cushion scale, *Iceryia purchasi* (Maskell) (CCS).

CCS was the most serious insect pest of citrus during the 1880s and threatened elimination of the crop from California. The pest originated in Australia. Beneficial insects were found in Australia during 1888 and imported into California. These beneficial insects included a predaceous ladybird beetle, *Rodolia cardinalis* (Mulsant) and a parasitic fly *Cryptochaetum iceryae* (Williston). These insects became established and were responsible for complete control of CCS (Doutt 1958). The exploration work was undertaken by Albert Koebele (1852–1924); George Compere was not associated with the spectacular success, but he did witness it. In part because growers were highly receptive to this kind of work, the State constructed the insectary in Sacramento.

Harry Smith reinstated foreign exploration after he became superintendent of the State Insectary in 1913. During that year he searched in Japan and the Philippines for natural enemies of mealybugs and scale insects attacking citrus. The work of others followed. The 1920s saw Smith increasingly involved in administrative duties with a continuing strong need for foreign exploration. The exploration work was conducted by Harold Compere. During his career, Compere imported natural enemies for numerous pests of citrus, most notably the black scale, California red scale and citrophilous mealybug.

1926–1927 Australia, New Zealand (Citrophilous Mealybug).—After control of CCS, the most serious pests of citrus in California were mealybugs, including citrophilous mealybug [*Pseudococcus calceolariae* (Maskell)], citrus mealybug [*Planococcus citri* (Risso)] and long-tailed mealybug [*Pseudococcus longispinus* (Targioni-Tozzetti)]. Before WW I biological control work on these pests had been limited to use of the coccinellid *Cryptolaemus montrouzieri* Mulsant which had been imported from western Australia by Koebele during 1892. The beetle was a general predator of mealybug whose success was limited. Considerable work was invested in collecting adults and transporting them elsewhere in California where pest outbreaks occurred. The problem was one of demand surpassing supply. The beetles could not be produced in large numbers because their mealybug prey could not be mass produced in the laboratory.

The citrophilous mealybug (CM) was first detected by C. P. Clausen (1893–1975) at Upland (near Riverside) during 1913. By the mid 1920s, this insect was recognized as the most significant pest, infesting more than 100,000 acres of citrus. *Cryptolaemus montrouzieri* was an established predator but it was not effective. Therefore, Compere was sent to Australia by Smith to search for natural enemies of the CM. In Sydney during March 1928 Compere recovered the parasitic wasps *Coccophagus gurneyi* Compere and *Tetracnemus pretiosus* Timberlake from a mulberry tree infested with CM. Compere returned from Australia during 1929 with these parasites and by 1931 *C. gurneyi* completely controlled this pest in California. The instance stands second only to the Vedalia beetle in importance in the annals of applied biological control. The trip cost the state of California

\$1700 but saved the citrus growers millions of dollars. The loss in revenue and cost of control of this pest would have been astronomically large had it not been controlled over the past 60 years.

1929–1930 Japan, China, India, Ceylon, Eritrea (Black Scale).—Black scale (BS) [*Saissetia oleae* (Oliver)] was first noted in California about 1880 and periodically had been a serious pest on citrus and olives. In the early years of southern California citrus, BS was regarded as the most serious pest. Africa has been generally regarded as the native home of BS. In 1917 E. J. Vossler (1890–1918) imported the encyrtid *Metaphycus lounsburyi* (Howard) from Australia, but this internal parasite was not consistent in its effect. Other natural enemies were imported earlier with inconsequential results.

For the 1929 trip Compere traveled via steamer and carried Wardian cages containing potted plants infested with BS. Several parasites of minor importance were collected at various localities. In earlier work on BS the celebrated Italian entomologist Filippo Silvestri (1873–1949) had reported parasites of BS in Eritrea. While in Eritrea, Compere exposed parasitic wasps to the scale insects and cultures were established. However, in Egypt the customs officials put all of his material in a warehouse where the temperature exceeded 120° F. All of his work was lost due to excessive heat. Compere continued to search for BS parasites throughout his career. In spite the efforts of Compere, and many other entomologists, BS remains a sporadic problem. Richards & Morse (1992) provide an excellent review of BS in southern California, including a list of natural enemies collected and imported by Compere.

1932–1933 Hong Kong, China, Pakistan, India, Ceylon (California Red Scale).—The California red scale (CRS) [*Aonidiella aurantii* (Maskell)] was first considered a serious problem in 1877. The pest was noticed by Thomas A. Garey and L. M. Holt. Garey was a member of the Southern California Horticultural Society, dealer in nursery stock and founding member of Pomona, California. Holt was secretary of the Horticultural Society and editor of the Society's journal. The CRS was found in Garey's stock during 1878, but not mentioned. Subsequent histories note that CRS was first discovered in 1879, without association to Garey. According to Compere, Garey was more concerned with the damage that knowledge of CRS would do to his business, than damage the scale would do to his plants (The Riverside Press, Tuesday, 26 Dec 1961). In 1892 natural enemies of CRS had been sent to California from Australia by Koebele. From 1900–1906 George Compere sent shipments intermittently from Australia to California. Silvestri searched in China during 1924–1925.

Harold Compere's objective in the orient was to find effective natural enemies of CRS. A basic tenet of classical biological control states that the most effective natural enemies of a pest are located in the center of endemicity of the pest. At that time CRS occurred virtually everywhere citrus was grown commercially. The origin of CRS was obscured by movement of many plants by commerce. If citrus was the original host of CRS, then logic dictated an oriental origin because that is where citrus originated. However, CRS was known to thrive and reproduce on several host plants and there was no firm reason to believe that CRS necessarily originated on citrus in its native home.

A notable achievement during this trip was that Compere discovered that preceding entomologists had misidentified yellow scale [then called *Chrysomphalus citrinus* (Coquillett)] for the California red scale [then called *Chrysomphalus au-*



Figure 2. Harold Compere in Pakistan during 1932.

rantii]. The discovery was important because these scale insects had been regarded as taxonomically indistinguishable. This discovery permitted entomologists to correctly sort parasite-host, host plant and distribution records.

We have little documentation of this trip (Fig. 2). When reviewing his importation records, we find that Compere did not significantly increase the number of species of parasitic Hymenoptera available for control of CRS. In fact, he later speculated that he had deliberately excluded species of *Aphytis* because he believed they were *A. chrysomphali*, a species ineffective in the control of CRS and known to exist in California. Later he recognized that a complex of species operated under this name (Compere 1961).

1934–1935 South America (California Red Scale).—Compere's objective in South America was to obtain natural enemies of citrus pests, principally parasites of the CRS. The trip was subsidized by Sunkist (formerly the California Citrus Growers Exchange). Compere's first port-of-call was Cartagena, Colombia on 25 Jul 1934. The excursion was brief. Only door-yard citrus was examined and no parasites collected. Next, he arrived at Puerto Rico on 27 Jul. Subsequent stops were made at Mayaguez, Port-of-Spain and Georgetown, but nothing was obtained.

Compere arrived at Rio de Janeiro on 18 Aug 1934. Brazil was the focal point of this trip because of its extensive citrus plantings. In Brazil, he encountered several obstacles. The Brazilian government prohibited removal of any botanical or zoological material unless similar material existed in the Ministry of Agriculture or National Museum. In Rio Compere's microscope was confiscated by Customs Officials. He was compelled to recover it at the American Embassy. [The writer had the same problem in Rio with the same microscope during 1978.]

Exploration in Brazil was less than spectacular. Citrus had been in Brazil since

the early days of Portuguese colonization. During the early part of the 20th century the citrus industry fell on hard times locally and many growers were shifting their agricultural efforts to cotton. Compere spent the last of August through November exploring Rio de Janeiro, São Paulo and Bahia. In São Paulo Compere worked with Edson Hambleton (1902–1980), and met Adolph Hempel, an American expatriot from Ohio who had worked on coccoids in Brazil since 1895. Hambleton lived in South America from 1929–1943 and was Professor and Head of the Escola Superior de Agricultura e Veterinaria in Vicosa and working on the mealy-bug genus *Pseudococcus* [For an obituary of Hambleton see Russell (1981)].

The following comments in a letter from Compere to Smith (11 Oct 1934) state rather well some aspects of foreign exploration. “The trip to Alagoinhas as a guest of the Government was not a great success. The train was scheduled to make the trip in 2½ hours. After traveling 2¼ hours we were informed the train was 2½ hours late. Arrangements had been made for a return at 4:00 P.M. Sunday night. At noon we learned that the schedule had been changed and our train had left at 4:00 A.M. Caldeira, the plant inspector escort, and the interpreter that I borrowed from the Consulate had to be in Bahia Monday morning. They approached me with an offer to pay their part if I would hire a car to take us to Bahia. It was not their funeral so I paid the entire cost. First we found a motor car driver who agreed to make the trip for 180 milreis. It rained as usual. Thick gumbo mud churned by cattle in the hilly country mired us down. For a distance of several miles horses towed and countrymen pushed. For at least once in my life I looked the part of a foreign explorer. Covered with mud, on a horse in a mud hole I had my picture taken for the benefit of my critics. It was rather enjoyable except for the uncertainty of whether we were to spend the night out in rural Brazil. The principal part of the entertainment at the Citrus Experiment Station was the Director performing difficult maneuvers on a new tractor for my benefit.”

The collections of Brazil for CRS were disappointing and the only species of promise were parasites of black scale. In Nictheroy, Compere found promising parasites of BS, including an undescribed species of *Coccophagus*. Compere was excited about this find because he felt that it offered a possibility of controlling BS in coastal California plantings where these parasites were probably too small for hyperparasites to attack. The collections in other countries of South America were not productive of parasites of CRS.

1936–1937 South and Central Africa (Black Scale, California Red Scale).—The trip to Africa was funded by Sunkist. This trip resulted in Compere collecting, importing and describing *Metaphycus helvolus* (Compere), now a dominant parasite of BS in California. Earlier, BS was kept under some biological control by *M. lounsburyi*. Over the years ecological conditions changed and the pest became more pernicious. When *M. lounsburyi* was imported into California, BS attacked many species of trees, including false pepper, citrus and olive. The scale occurred in so-called “uneven broods.” That is, a tree could harbor all stages of BS at all times. Female *M. lounsburyi* attacked the “rubber-stage” which occurred immediately before adulthood. Over time, the impact of *M. lounsburyi* was such that the parasite induced the host to become even-brooded, or development was shifted such that long periods lapsed when the suitable host stage was not available. As a consequence, parasite populations declined.

Olive and citrus infested with BS became more widespread in the even-brood. False pepper continued to produce "uneven brooded" BS which in turn supported low populations of *M. lounsburyi*. The explanation given for this condition was that false pepper continued to produce new growth which favored scale development. Control of BS was still regarded as good because before the importation of *M. lounsburyi*, BS would frequently kill the trees. Importation of *M. helvolus* resulted in good control of BS, particularly along the coast of California, although the success was not as spectacular as that witnessed with the CCS or the citrophilous mealybug. Control of BS with *M. helvolus* was such that the pest became a problem only through pesticide upset. In the interior regions of California where the scale was even-brooded, the scale was completely controlled. Some insectaries shifted their activities from production of citrophilous mealybug parasites and *Cryptolaemus* to the production of *M. helvolus*. Many other parasites were imported by Compere during this trip including *M. stanleyi* Compere, *Coccophagus rusti* Compere and *C. cowperi* Girault.

1947–1948 South Africa, East Africa, Zanzibar (*Codling Moth, Grape Mealybug, Citrus Red Mite*).—Foreign exploration was impossible during World War II. Compere was too old for military service and he remained in Riverside at the Experiment Station working on entomological projects (Fig. 3). Following the War, Smith sent Compere to South Africa in search of natural enemies for several citrus pests, including CRS, citrus red mite, long-tailed mealybug, and Baker's mealybug. During the war years, mealybugs had become a problem in Orange and Los Angeles Counties, red scale was a perennial problem and citrus red mite was becoming a more serious pest.

This was Compere's last foreign exploration trip. He arrived in Capetown 21 Mar 1947. The trip to Africa had been authorized nearly two years earlier and was confounded by delays. Compere wanted a car for exploration in South Africa. His experience from the earlier trip to South Africa led him to feel this would give him the mobility necessary to work effectively. During the period following WW II, new cars were difficult to secure and it took Compere nearly eight months to obtain a 1946 Chevrolet. After he purchased the car another eight months passed before he secured passage on a steamer for himself, Joan and the car. The first month in Capetown was spent with the police, traffic control, insurance, immigration and related activities.

Moving around within South Africa was difficult due to police and immigration regulations. The housing problem was acute in Capetown. In large part, housing accommodations dictated collecting plans. He would not relinquish occupancy of one lodging until another had been secured. If Compere had not brought a car, then living conditions would have been considerably worse. The cost of living had skyrocketed. He was required to pay for meals missed at boarding houses and hotels. In a letter to Smith, Compere estimated that the cost of the visit doubled while the productivity was reduced. The difficulties were partially compensated by the generous loan of a fully equipped laboratory at the Low Temperature Laboratory on Portsworld Road, Capetown by Mr. Rees-Davies.

Compere's objectives in the Cape involved the codling moth [*Cydia pomonella* (Linnaeus)], predatory coccinellids and the grape mealybug (GM) [*Pseudococcus maritimus* (Ehrhorn)]. Smith was anxious to obtain codling moth parasites reared



Figure 3. Harold Compere in Riverside during 1940.

at the Western Province Research Institute. When Compere arrived in Stellenbosch during Apr 1947 he found none to spare for export to California. Consequently he shifted his attention to other objectives. He had seen a coccinellid feeding on CRS at Clanwilliam in 1936 and hoped to locate it again. Also in the Cape the so-called GM was known as a pest of grapes only. During 1936 he could

not find this pest on citrus, ornamentals or deciduous fruit. Compere speculated that the pest on grape in the Cape was not the same as that in southern California.

Compere visited Clanwilliam 16–17 Apr 1947. The CRS picture had changed considerably from his earlier visit. In 1947 he noted citrus trees being killed by CRS infesting the branches. The situation was so dramatic that in one grove more than 10,000 dead citrus trees had just been removed. Compere could not find the coccinellid he had seen earlier and the only natural enemies located were *Chilocorus lophanthae* (Blaisdell) and an *Aphytis*, presumably *chrysomphali* (Mercet).

During May 1947 he visited the Letaba Estates of northeastern Transvaal near the Murchison Range. The estate was owned by a Dr. Merensky, a German geologist and mining engineer who arrived in Southwest Africa during 1908 and explored Namaqualand. Returning to Germany in 1909, Merensky wrote a paper which predicted the existence of diamonds in the alluvial deposits not connected with the Kimberley Mines. Merensky's paper went unnoticed so he put together enough money to explore the area in 1926. He discovered diamonds in Namaqualand as predicted, filed mining rights to 20 claims, sold these in 1928 and went into agriculture. Merensky was Compere's host at Letaba.

The Estate consisted of about 200,000 acres planted half in Valencia and half in Navel oranges. CRS was as abundant as in southern California. As in California, the navels were more heavily infested and more prone to attack by CRS than Valencias. Compere noted that the trees at Letaba sustained heavier infestation and recovered more rapidly than trees planted in California. Letaba provided a superb natural laboratory for the study of CRS as it affected citrus. Nowhere in his travels had he encountered a problem of this magnitude under the control of one grower. The climatic conditions were comparable with California but the summer was slightly warmer than Orange County. May was considered winter in Transvaal but he recorded *Aphytis chrysomphali* and coccinellid predators as abundant. The distribution of CRS was not even and the distribution of parasites was not straightforward. Although this visit was informative, it was not productive in terms of new natural enemies.

Compere reluctantly visited Zanzibar during October and November 1947. Bureaucratic entanglements with his car and the problems of securing living accommodations enhanced Compere's reluctance to voluntarily move. Smith seconded Compere to the Pacific Science Board to search for *Scolia ruficornis* (Fabr.), a wasp parasitic on the beetle *Oryctes rhinocerus* (L.), then a serious pest of coconut palm in the South Pacific. Compere had been in Nairobi during July thru September. Smith finally ordered Compere to undertake the work, an action which both men found unpleasant. In more than 25 years of association Smith never ordered Compere to do anything. Smith always relied on Compere's judgement to act independently in the field. F. X. Williams of the Hawaiian Sugar Planters Association replaced Compere in this work.

Compere returned to Nairobi and was operated on 9 Jan 1948 for an hernia. Ten weeks later the hernia reappeared. Medical attention was provided at the European Hospital in Nairobi, the same hospital in which Joan was resident three months with a broken leg. During April 1948 he was particularly interested in working with parasites of long-tailed mealybug in Kenya. He recovered a species of an *Anagyrus* near *A. maritimus* which had been sent to California earlier.

Compere later described the parasite as *Anagyrus kivuensis*. Compere felt that if the parasite did succeed that it would justify the trip to Africa. In Kenya this parasite was rated as the most important parasite of coffee mealybug, *Planococcus kenyae* (LePelly). At this time S. E. Flanders made requests for *Chilocorus wahlbergi* Mulsant. Compere located this coccinellid in navel orange groves at Thika which were heavily infested with California and Florida red scale, purple scale, russet mite and red spider mite. The occurrence was particularly noteworthy because Compere had standing orders to secure natural enemies of RSM. He located staphylinid larvae feeding on this mite on avocado, but apparently other insects were not observed feeding on this pest.

By June 1948 Compere was looking forward to returning to the United States. The medical problems encountered by Harold and Joan had been significant. This, coupled with the poor collecting conditions in Kenya, hastened his attempt to depart for home. Unfortunately, the political situation complicated matters. His Chevrolet, according to Kenya law, had to be sold at a price fixed by the Controller of Motor Vehicles. Payment was to be in East African shillings and could not be converted into U.S. dollars legally. To further complicate matters removal of large sums (including shillings) from East Africa was prohibited.

DOMESTIC EXPLORATION

1951 (Western Grape Leaf Skeletonizer).—Compere's last expedition for natural enemies was to the Atlantic and Central States for parasites of *Harrisina americana* (Guerin) which might be used in California against *H. brillians* (GLS) Barnes & McDunnough. The trip (13 Jul–26 Sep 1951) involved 17 shipments. At the time GLS was a significant pest of grapes in California. Smith had retired shortly before Compere's trip, but Smith directed the project. He believed that beneficial insects could be obtained from the east. Compere selected Columbus, Ohio as the starting point owing to its central location and because *H. americana* had been recorded from there, but had not achieved pest status in commercial plantings of grapes. The trip was made by car and he engaged in virtually no collecting along the way to Columbus because of the lateness of the season and prevailing weather conditions.

Compere visited grape plantings in Ohio which revealed nothing. He shifted to New York due to the reported outbreak of *H. americana* in 1949 at Cayuga County. Unfortunately, Compere could not locate the site of the reported infestation. Plantings of grapes were infested with another skeletonizer, not *H. americana*. P. J. Hartzell at the Geneva Experiment Station suggested Compere try the Hudson Valley but this exploration was unproductive. A subsequent visit to New Jersey revealed nothing. Compere next tried Pennsylvania because *H. americana* was considered a pest there. The Lepidopterist S. W. Frost took Compere to Shingletown Gap where the first collection of *H. americana* larvae was made and shipped to Riverside on 9 Aug. A second shipment was sent from material taken at Morganstown, West Virginia on 13 Aug 1951.

Compere had been plagued with asthma and the condition had become intolerable. Compere went to Florida for relief and where there was some promise of finding natural enemies. A shipment of larvae was taken near Jacksonville and sent to Riverside on 17 Aug. Additional collections were taken at Jacksonville which revealed parasites, and another collection made at Titusville. On 1 Sep he

left the state and next made a small collection in Tennessee. The trip yielded nothing of substance and must be regarded as a failure.

COLLECTING TECHNIQUES

Harold Compere was among the most successful collectors in terms of number of species obtained abroad, the number of establishments in California and biological control achievements. His methodology probably influenced his performance record. Compere's approach to foreign exploration remained essentially constant throughout his career and is best summarized in his own words in a letter to S. E. Flanders dated 9 Jun 1947. "I am more than ever of the opinion that sidewalk exploring in the big cities is far more profitable than orchard exploration. However, sidewalk exploring is [sic] neat and dirty work. Orchard exploring is a grand life, especially in Africa where the total citrus plantings are about equal to those of Tulare County. . . . In the past I have been criticized for not getting out into the orchards." Someone with foreign exploration experience can appreciate the wisdom in Compere's words. The threat to personal safety has always been a real and persistent problem. Dogs were Compere's particular nemesis and he always carried a pair of oversize gardener's shears for self protection on sidewalk exploration.

SYSTEMATIC STUDIES OF PARASITIC HYMENOPTERA

From the standpoint of applied biological control, parasitic Hymenoptera are among the most important beneficial insects. Many of the insects which he collected were new to science. Taxonomy of the parasitic Hymenoptera was in a confused state and there were too few taxonomists working on these wasps to provide rapid and correct identifications. P. H. Timberlake was hired to work on the taxonomy of parasitic Hymenoptera but he shifted interests and worked on the taxonomy of bees. These facts made Compere's involvement in taxonomy imperative. Between foreign exploration trips, Compere focused his attention on the taxonomy of parasitic Chalcidoidea, mostly Aphelinidae and Encyrtidae. These families are numerically large, taxonomically difficult and represented the bulk of the material collected by Compere. The descriptions of his species may be found in the publications listed below.

Compere was a self-educated taxonomist whose work with aphelinids is noteworthy. Compere (1931) provided the first modern revision of *Coccophagus*, a cosmopolitan genus consisting of about 200 species. Members of the genus demonstrate complex biological habits and may serve as primary or secondary parasites. Compere (1955) also developed the first revisionary study of the genus *Aphytis*. Species of *Aphytis* are the primary parasites of armored scale insects and are important in control of diaspidids (Rosen & DeBach 1978). The history of *Aphytis* in biological control makes a compelling story. Aspects of that history were provided by Compere (1961) in his classic paper on the California red scale. Before Compere's work, *Aphytis* contained only a few species. He described several species and drew attention to several species which were morphologically similar and biologically useful. His taxonomic studies served as the foundation for the work of Paul DeBach (1913–1992) in applied biological control of scale insects. DeBach, with graduate students and colleagues, pointed to the existence of numerous sibling species complexes within *Aphytis*. Presently we recognize more

than 200 species of *Aphytis* with many species remaining undescribed (Rosen & DeBach 1979).

Compere's work in the Encyrtidae was less significant but still worthy of mention. This family contains about 500 genera and more than 3,300 species. All species are primary or secondary parasites. Most hosts are Homoptera and consequently the family holds importance in control of many pests. Compere worked on some important genera, such as *Metaphycus* and *Aphycus*, but he did not publish improvements in the classification of the family. The Encyrtidae were too large and knowledge was too diffuse for Compere to make a significant improvement in their taxonomy.

Harold Compere retired as Specialist on 1 Jul 1963. He did not hold an academic appointment and consequently he was not entitled to the privileges accorded emeriti. A petition was made in his behalf and he was accorded emeritus status. A petition was made to award him an honorary Ph.D., but this was denied because the University of California did not engage in this practice at the time. Once, Compere had been appointed to the faculty. However, this placed him under a less desirable retirement system. He successfully sought to have the appointment eliminated and his status as a Specialist reinstated.

As a Specialist, Compere could not supervise graduate students, but he did influence some of them who passed through Riverside. Paul DeBach was first attracted to biological control after seeing a photograph in the Los Angeles Times of Harold Compere on a camel in Eritrea. During the 1950s and early 1960s Compere worked with the Italian Giulio Zinna. Unfortunately, after returning to Italy, Zinna committed suicide and prematurely terminated a potentially productive partnership. Compere also collaborated with the noted South African chalcidoid taxonomist David P. Annecke (1928–1981).

Compere had a strong interest in morphology and held a great admiration for Gordon Floyd Ferris (1893–1958). During the latter years of life Harold Compere became obsessed with principles of morphology as they related to chalcidoid classification (see his last publications below). He felt that classifications should be phylogenetic in the sense that they reflect evolutionary modification of anatomical features. The higher classification of the Chalcidoidea has always been confused, in part due to the large number of species and bewildering array of anatomical modifications. Compere thought that his retirement pastime would be the clarification of taxonomic relationship through detailed analysis of anatomical structure.

Compere undertook a detailed morphological analysis of all Hymenoptera with a goal of demonstrating homology and tracing modification through descent. His approach was sound in that he would take representatives of many families of chalcidoids and study them part-by-part in a comparative manner. His notion of a perfected classification embraced the concept of shared derived characters. He was tormented by the fact that he could not find a common groundplan for many important structural features in the groups which he studied. He agonized over these problems for nearly fifteen years following retirement. He would draft manuscripts considering each anatomical feature in some detail. Unfortunately the gaps between taxa he studied were tremendous and he could not account for modifications or trends of change given his limited selection of data points. In the end he quit and all that remains of his studies are boxes of slides with his dissections,

photomicrographs and reams of unpublished text. Final abandonment of morphological studies came around 1975. Simply put, the problem exceeded his ability.

Harold Compere died 3 Feb 1978 at his home at 1900 Bonnie Brae, above Tequesquite Arroyo, at Riverside, California. He was cremated and his ashes interred at Rosedale Cemetery in Los Angeles, a few city blocks from the house in which he was born.

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